WOODSIDE PRIORY SCHOOL

COURSE OUTLINE – HONOR CHEMISTRY

Instructor: Mr. G. Tang **Phone:** (650) 851-6129

Office Hours: 8:00 AM – Start of 1st Class (Except Wednesdays) **Email:** gtang@woodsidepriory.com
End of Last Class – 4:00 PM (Tuesdays, Thursdays); B and G Blocks

Required Text: Wilbraham, Anthony C., Staley, Dennis D. Matta, Michael S., Waterman, Edward L. *Chemistry*. 5th ed. Addison-Wesley, 2002 (ISBN: 0-1305-4384-5)

Required Material: TI-83 Plus or TI-84 Plus Graphing Calculator, Separate Bind (Composition) Notebook as Labs and Activities Log, 1½-inch 3-ring Binder, Dividers

Course Overview:
Chemistry is the study of matter and its changes. Through the study of chemistry at the honor level, students are given an opportunity to explore and understand the natural world and to become aware of the profound influence of chemistry in their lives.

Chemistry, as with all sciences, is an experimental discipline requiring creativity and imagination. Methods of inquiry characterize its study. In Honor Chemistry, students further develop their ability to ask questions, investigate and experiment; to gather, analyze and assess scientific information; and to test scientific laws and principles and their applications. In the process, students exercise their creativity and develop their critical thinking skills. Through experimentation, and problem-solving activities that include the integration of technology and independent study, students develop an understanding of the processes by which scientific knowledge evolves.

Students are active learners and will assume increased responsibility for their learning as they work through the program. A through study of chemistry is required to give students an understanding that encourages them to make appropriate applications of scientific concepts to their daily lives and prepares them for future studies in chemistry. Students are expected to participate actively in their own learning. An emphasis on the key concepts and principles of chemistry provides students with a more unified view of sciences and a greater awareness of the connections among them.

Science, Technology and Society (STS)
In addition to scientific knowledge, *students will be expected to demonstrate* an understanding of the processes by which scientific knowledge is developed, and of the interrelationships among science, technology and society, including:

- The central role of evidence in the accumulation of knowledge, and the ways proposed theories may be supported, modified or refuted.
- The inability of science to provide complete answers to all questions.
- The functioning of processes or products based on scientific principles.
- The ways in which science advances technology and technology advances science.
- The use of technology to solve practical problems.
- The limitations of scientific knowledge and technology.
- The influence of the needs, interests and financial support of society on scientific and technological research.
- The ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

Course Content and Tentative Timeline
In some cases, the concepts listed below correspond to another chapter in the textbook. A detailed reading list and assigned problems will be available at the beginning of each unit.

Unit 1: Basic Chemistry

Chapters 3 & 4: Scientific Measurement & Problem Solving in Chemistry **1.0 week**
Lab Safety, Metric System, Uncertainty, Significant Figures, Density, Temperature, Unit Analysis, Conversion of Complex Units

Chapters 2 & 5: Matter and Change & Atomic Structure and the Periodic Table **1.0 week**
Classification of Matter, Solutions, Elements and Compounds, Physical Change and Chemical Reactions Models of the Atom, Structure of a Nuclear Atom, Periodic Table of Elements, Metals and Nonmetals, Groups and Periods, Atomic Orbitals

Chapter 6: Chemical Names and Formulas **1.0 weeks**
Properties of Ionic and Molecular Compounds, Introduction to Ionic and Covalent Bondings, Nomenclature of Ionic and Molecular Compounds, Complex Ions, Acids Nomenclature

Chapter 7: Chemical Quantities **0.5 week**
Mole, Molar Mass, Mole-Mass Conversions, Percent Composition, Empirical and Molecular Formulas

Unit 2: Matter as Solutions and Gases

Chapters 17 & 18: Water and Aqueous Systems & Solutions **2.0 weeks**
Properties of Water, Solute and Solvent, Process of Solution, Electrolytes and Non-Electrolytes, Factors of Solubility, Solubility Rules and Table, Qualitative Analysis of Ions, Concentration, Mole-Concentration Conversions, Molarity, Percent Composition, Solution Preparation, Dilution

Chapter 12: The Behavior of Gases **1.5 weeks**
Pressure, Boyle, Charles and Avogadro Gas Laws, Combined Gas Law, Ideal Gas Law, Avogadro's Law, STP and SATP, Kinetic Molecular Theory of Matter, Solubility of Gases, Real Gases, Dalton's Law of Partial Pressure, Vapour Pressure, Graham's Law of Effusion, Henry's Law of Solubility of Gas, Colligative Properties (Freezing Point Depression and Boiling Point Elevation), Phase Diagram

Unit 3: Quantitative Relationship in Chemical Change

Chapter 8: Chemical Reactions **1.5 weeks**
Evidences and Types of Chemical Reactions, Predicting Reactants and Products, Writing and Balancing Chemical Reactions

Chapters 9: Stoichiometry **1.5 weeks**
Gravimetric, Solution, and Gaseous Stoichiometry, Limiting Reagents, Percentage Yield

Unit 4: Chemical Bonding

Chapter 13: Electrons in Atoms **1.0 week**
Bohr Atoms, Quantum Model and Number, Atomic Orbital, Electron Configurations, Atomic Orbitals and Orbital Energies, Pauli Principle

Chapter 14: Chemical Periodicity **1.0 week**
Periodic Trends in Atomic Radii, Ionization Energy, Ionic Sizes, and Electronegativity

Chapters 15 & 16: Ionic Bonding and Ionic Compounds & Covalent Bonding **2.0 weeks**
Valence Electrons, Octet Rule, Electron Configurations of Cations and Anions, Lewis Structures, Ionic Bonds and Properties, Single Covalent Bonds, Double and Triple Covalent Bonds, Exceptions to Octet Rule, VSEPR Model, Hybridization, Bond Polarity, Polar Molecules, Intermolecular Bonds (van der Waals Forces – [London Forces, Dipole-Dipole Interactions] and Hydrogen Bonding), Properties of Covalent Bonds

Unit 5: Organic Chemistry

Chapter 25: Hydrocarbon Compounds **1.5 weeks**
Nomenclatures and Structural Formulas of Alkanes, Alkenes, Alkynes, Aromatics, and Cyclic Alkanes, Structural Isomers, Petroleum Processing

Chapter 26: Functional Groups and Organic Reactions **1.5 week**
Nomenclatures and Structural Formulas of Halogen Substituents and other Functional Groups, Various Organic Reactions including Addition, Elimination, Substitution, Combustion, Cracking, Reforming and Esterification, Polymers

Unit 6: Thermochemistry and Nuclear Chemistry

Chapter 11: Thermochemistry – Heat and Chemical Change **3.0 weeks**
Enthalpy, Thermochemical Equations, Heats of Formation, Potential Energy Diagrams, Heats of Reactions, Hess's Law, Calorimetry

Chapter 28: Nuclear Chemistry **1.0 week**
Isotopes, Radioactive Decay, Nuclear Transformations, Nuclear Equations, Half-lives, Nuclear Particle Emission, Fission and Fusion, Nuclear Energy Production

Unit 7: Chemical Kinetics and Equilibria

Chapter 19: Reaction Rates and Equilibrium **3.0 weeks**
Collision Theory, Activation Energy, Factors affecting Reaction Rates, Catalysts, Reversible Reactions, Le Châtelier's Principle, Equilibrium Expressions, Constants and Concentrations, Solving Simple Equilibrium Problems, Entropy, Free Energy

Unit 8: Acids and Bases

Chapter 20: Acids and Bases **2.0 weeks**
Physical Properties of Acids and Bases, Arrhenius, Brønstead-Lowry and Lewis Definitions, Strong and Weak Acids and Bases, pH and pOH, K_a and K_b Expressions, K_w, Degree of Ionization / Dissociations, Polypro tic Acids and Bases

Chapter 21: Neutralization **2.0 weeks**
Amphiprotic Acids and Bases, Writing Complete and Net-Ionic Neutralization Reactions, Titrations and pH Curves, Indicators, Equivalent Points and Endpoints, Buffer Solutions, Salt Hydrolysis, Solubility Equilibria and Solubility Product

Unit 9: Electrochemistry

Chapter 22: Oxidation-Reduction Reactions **2.0 weeks**
Oxidation and Reduction Definitions, Oxidizing and Reducing Agents, Writing and Balancing Oxidation and Reduction Half Reactions, Strengths of Redox Reagents, Oxidation Numbers, Balancing Half Reactions Using Oxidation Number in Acid / Base Solutions, Redox Titration,

Chapter 23: Electrochemistry **2.0 weeks**
Standard and Net Electric Potentials, Electrochemical (Voltaic / Galvanic) Cells, Electrolytic Cells, Faraday's Laws

Semester 2 Final Exam Review **1.0 – 2.0 weeks**
Students will review old unit tests, with the emphasis on the last 5 units of the course.

Semester One (September to December)

Units	Weight
Unit 1: Basic Chemistry	18%
Unit 2: Matter as Solutions and Gases	18%
Unit 3: Quantitative Relationship in Chemical Change	22%
Unit 4: Chemical Bonding	22%
Semester 1 Final Exam (December)	*20%*
Total Course Mark	**100%**

*The 1st Quarter Mark will consist of Units 1 and 2. The 2nd Quarter Mark will consist of Units 3 and 4.

Semester Two (January to June)

Units	Weight
Unit 5: Organic Chemistry	13%
Unit 6: Thermochemistry and Nuclear Chemistry	19%
Unit 7: Chemical Kinetics and Equilibria	15%
Unit 8: Acids and Bases	15%
Unit 9: Electrochemistry	18%
Semester 2 Final Exam (Beginning of June)	*20%*
Total Course Mark	**100%**

**The 3rd Quarter Mark will consist of Units 5, 6 & 7. The 4th Quarter Mark will consist of Units 8 & 9.

Unit Components	Weight
Homework / Notebook	20%
Labs	30%
Quizzes	10%
Unit Test	40%
Total Unit Mark	**100%**

Unit Preparation
At the beginning of each unit, a detailed timeline of readings and problems are given out to students. This is to allow students the opportunity to better manage their studying schedule. It is highly recommended that students do the assigned reading from the text to prepare for the next class.

Homework
Homework will be assigned every class. All answers of assigned problems are in the back of the textbook. Students are encouraged to ask problems they do not understand in the next class. Homework check will be conducted regularly. It is important that students do the assigned problems to self-evaluate their understanding of the material taught.

Notebook
An organized notebook is a key to success in any course. Students are to keep their current chapter's work in a 1½-inch 3-ring binder. It should have several dividers. The chapter outline will be placed at the beginning, follow by class notes with all answers to the examples filled out. Then, a section of homework follows, and finally chapter quizzes that has been handed back. This chapter notebook is turned in during the chapter test. After each chapter test, students are to put all material of that chapter in a central binder at home. The new chapter will now be house in the emptied binder to be carried to and from class.

Labs
Labs will be conducted in each unit. *All Safety Procedure MUST be followed at ALL times*. Proper lab techniques will be introduced. It is required that students are to read up on the lab procedure prior the lab period.

There are about 9 labs within this course. They are crucial components of the Chemistry program. Students who have missed a lab period must arrange other times (before or after school) to perform the lab. Students must perform the lab on their own unless otherwise stated, and each should hand in their own lab report. Students should have a separate bind notebook as their lab notebook. The entire notebook should be handed in for evaluation every time a lab report is due.

Note: If students wish to type up their lab reports, a three-ring binder can be used to collect all reports graded. In such case, a *Title Page* indicated the title of the lab, student's name; class and instructor must be included with the report when it is due. Proper word processing techniques, such as subscripts, superscripts, arrows, double arrows, and math equations should be used. Because of the amount of mathematical calculations involved in these labs, students are strongly encouraged to write up their lab reports instead.

Lab Report Format

1. **Title and Date:** A Short Description of the experiment
2. **Objective:** Describe the Background and the Purpose of the experiment. What is it that we are expected to learn and accomplish from this experiment?
3. **Hypothesis:** An Educated Guess of the result of the experiment. Predict any observations. This is also the section where you will answer any prelab questions. Example: Products Prediction, Concentration of a solution …etc.
4. **Materials:** A Detailed List of all Equipment and Amounts of Chemicals Used. The list can be found in the lab itself.
5. **Procedure:** Even though the procedure is provided in the lab, students should not merely copy the steps. The procedure is to be paraphrased into your lab report. All universities and colleges are against any form of plagiarism. All quotes and materials must be properly referenced.
6. **Observations:** All relevant Quantitative Data must be recorded. The measurements that need to be taken should have been conveyed in the objective, hypothesis and procedure. All Qualitative Data must be recorded as well.
7. **Analysis:** This section consists of all Calculations and Graphs from the Experimental Data. All calculations must include proper units and all parts of any graphs are properly labeled. Any Inferences from the Qualitative Data should also be included.

8. **Evaluation:** When there are both theoretical and experimental results, percentage yield or percentage error must be calculated. This value must be explained and accounted for (What were the kinds of errors made in the lab?). Suggestions to improve the lab procedure must also be provided.

$$\% \text{ Yield} = \frac{\text{Experimental}}{\text{Theoretical}} \times 100\% \qquad \% \text{ Error} = \frac{\left| \text{Theoretical} - \text{Experimental} \right|}{\text{Theoretical}} \times 100\%$$

9. **Conclusion:** Finally, comment on whether your have met the objective and what have you learned from this lab.

The first five sections (title to procedure) and the list of measurements needed for the observation must be completed prior to any lab periods. This is to ensure students have read and understood the lab before hand.

Quizzes
A quiz is given at the end of each chapter or in the middle of a chapter. They serve as interim assessment on material taught. Students are encouraged to study and learn from the mistakes in these quizzes to better prepare of the unit test.

Unit Test
There will be a unit test given at the end of each unit. These are comprehensive tests that will cover all components taught (including labs performed) within a unit. Most unit tests will be in the same style and format to the midterm and final exam.

Semester 1 Final Exam
The Semester 1 Final Exam will be held in December prior to the Christmas Break. It will cover the first 4 units of this course.

Semester 2 Final Exam
The Semester 2 Final Exam will be held at the beginning of June. Although all units will be tested, the last 5 units will be the focus of this final exam.